layer in a mole fraction of from about 0.29 to about 0.49, and the aluminum oxide is present in the layer in a mole fraction of from about 0.17 to about 0.29, each mole fraction being based on the total moles of niobium oxide, silicon oxide and aluminum oxide in the layer.

REMARKS

Claims 1-3, 11-12 and 19-21 are presently pending in the application.

Claims 1, 11-12 and 19-20 have been amended in view of the Examiner's indefiniteness rejections of claims 1-3 and 12 regarding the presence of a substrate as set forth in Paper No. 5. Specifically, claims 1 and 12 have been amended to note the coating is for use on a substrate. This is supported in the specification, at least at page 11, line 14 to page 14, line 4 and the Examples. Claims 11 and 19 have been amended to clarify a preferred embodiment of the invention in which the melting temperature of the substrate is less than or equal to about 450 °C. Support for this amendment is in the specification, at least at page 13, lines 12-14. Finally, claim 20 has been amended to include the subject matter of the canceled claim 14 to correct that claim. In addition, new claim 21 has been added. This claim is identical to claim 13 which was inadvertently canceled due to a typographical mistake in applicants' Response to Restriction Requirement filed on April 28, 2000. No new matter has been added by these amendments.

The Examiner has rejected claims 1-3, 12, and 20 under 35 U.S.C. § 112, second paragraph, as being indefinite. Specifically, the Examiner argues that claims directed to a coating *per se* without the coated article are improper in form. With regard to claim 2, the Examiner is unclear as to the meaning of "low" in the phrase "low-temperature cured." Finally, claim 20 has been rejected for depending on a canceled claim. In response to this rejection, independent claims 1 and 12 have been amended to recite that the coating is used on a substrate. Applicants respectfully

traverse the Examiner's rejection of claim 2 under § 112. The term "low-temperature cured" is adequately defined in applicants' specification in various places including page 13, line 3 to page 14, line 4. As such, the Examiner's rejection is inappropriate and applicants respectfully request withdrawal of that rejection. Finally, claim 20 has been amended to include the subject matter of claim 14 so it is no longer an improper dependent claim. Consequently, applicants respectfully request reconsideration and withdrawal of the § 112 rejection of that claim.

Rejection Under 35 U.S.C. § 103(a) Based on Adair and Özer

The Examiner has rejected claims 1, 11, 12 and 19 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,728,456 of Adair, *et al.* ("Adair") and the reference by Özer, *et al.* entitled "Optical and Electrochemical Characteristics of Niobium Oxide Films..." ("Özer"). Applicants respectfully, but strenuously, traverse this rejection.

The Examiner argues that Adair discloses an antireflection coating with a layer of a refractive index higher than 1.8 or 2.0 made of materials such as titanium oxide, zirconium oxide and niobium oxide, among others. Adair allegedly teaches that the coating is intended for use on plastic or glass substrates which are known to have melting points higher than 100 °C. Although the Examiner acknowledges that Adair fails to disclose that the layers are made by sol-gel techniques, the Examiner argues that Özer discloses similar layers made by sol-gel techniques and magnetron sputtering. The Examiner thus concludes that it would have been obvious at the time of the invention to prepare the layers by either technique since both films are alleged to show similar optical properties.

When making a rejection under 35 U.S.C. § 103(a), the Examiner has the burden of establishing a prima facie case of obviousness. In order to establish *prima facie* obviousness, the

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Examiner must make all of the following showings: (1) there must be some suggestion or motivation to combine the references as suggested by the Examiner (it is not sufficient to say that the cited references can be combined without a teaching in the prior art to suggest the desirability of the combination); (2) there must also be a reasonable expectation of success; and (3) the references must teach or suggest all limitations of the claims. The teaching or suggestion to combine the applied art and the reasonable expectation of success must be found in the prior art and not in the Applicant's specification (MPEP § 2143).

Adair teaches absorbing antireflection coatings which exhibit optical properties characterized by large bandwidths, and which are stated to be simple and cost effective to produce (col. 6, lines 29-34). The two-layer coatings of Adair comprise: (1) an outer thin layer of transparent material having a low refractive index (between 1.30 and 2.0), which is preferably SiO_2; and (2) a very thin inner layer having a high index of refraction of greater than 1.8 of absorbing, electrically conductive, transition metal oxynitride material (col. 8, lines 36-44). More specifically, Adair teaches that the inner layer comprises a transition metal combined with non-stoichiometric quantities of both nitrogen and oxygen. Although titanium is the preferred transition metal, other transition metals known to form oxynitrides can also be used, including, among others, niobium (col. 9, lines 51-54 and 65-67).

Adair does not teach, as the Examiner contends, that the high refractive index layer in Adair's invention can be made of materials including niobium oxide. Adair does not teach or suggest that niobium oxide alone is applicable as a sol-gel derived high index of refraction layer having an index of at least 1.9. The coating of Adair is based on transition metal oxy*nitrides*. In fact, in both of the Examples of Adair, titanium, the preferred transition metal, is utilized. Adair is not directed to teaching that the use of Nb_2O_5 itself as a high refractive index material is new, and

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applicants' invention is also not so directed. Rather, as will be discussed further below, applicants' invention provides a high refractive index (RI >1.90) niobium oxide layer formed using sol-gel technology. Applicants' coatings can be cured at low temperatures and thus are useful for coating on low-melting point substrates such as plastic substrates.

The deposition method taught by Adair is in-line magnetron sputtering (col. 13, lines 25-27). Although such a method is known to be applicable for coating various substrates, magnetron sputtering is an expensive process and is highly uneconomical. Applicants have discovered in the present invention a sol-gel derived layer which can be cured at low enough temperatures for use on plastics. The sol-gel derived layer forms the basis for applicants' invention. Applicants are not claiming the novelty of using niobium oxide as a high RI coating material. Rather, applicants are claiming a sol-gel derived layer of niobium oxide which has high enough RI for use as an "H" layer in optical coating systems (RI > 1.90). Such coatings can be cured at low enough temperatures to be used on a low-melting temperature substrates like plastic and still maintain a high refractive index greater than 1.90.

Özer teaches electrochromic niobium oxide (Nb_2O_5) coatings which were prepared by both sol-gel spin coating and magnetron sputtering techniques. The Nb_2O_5 films were analyzed to compare the optical and spectroelectrochemical properties resulting from the two methods of preparation. Özer concludes that the refractive indices of the films were, in fact, dependent upon the preparation technique, contrary to the Examiner's suggestion that the techniques are equivalent. Specifically, the refractive indices for the sol-gel deposited films (1.82) were significantly lower than those of the sputtered films (2.28). Clearly, the films prepared by the two methods do not exhibit similar optical properties.

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The Examiner argues that it would have been obvious at the time of the invention to prepare the high refractive index layer taught by Adair by either sol-gel or magnetron sputtering techniques since both films showed similar optical properties, and points in particular to the abstract. Applicants respectfully traverse the Examiner's conclusion. Initially, applicants can find no mention in the abstract of either Adair or Özer that both films showed similar optical properties. In fact, there is no rationale for combining Adair and Özer because the references themselves teach against such a combination. Adair only discloses preparation of layers by sputtering, and in the abstract states, "one important advantage of the present invention is that, due to the simplicity of the design and the suitability and efficiency of deposition of the materials in an in-line DC reactive magnetron sputtering process... the antireflection coatings ... can be produced in a very cost-effective manner" (Abstract). Furthermore, Özer states in the abstract, "the refractive index and electrochromic coloration [of the films] were found to depend on the preparation technique."

There is nothing in Adair to teach or suggest utilizing an alternative technique for the preparation of the layers, because the sputtering technique is the only one disclosed for use in that invention. In addition, the high refractive index layer of Adair has a refractive index of preferably greater than 1.8, and most preferably greater than 2.0 resulting from sputtering (col. 6, lines 21-22). Since Özer demonstrates that the sol-gel derived films have lower refractive indices than those produced by magnetron sputtering, there would be no teaching in Özer to motivate one of ordinary skill in the art at the time of the invention to switch the method of Adair to a method which would produce films with a *lower* refractive index than those already achieved in Adair for use in a high index layer. In fact, Özer would teach away from applicants' invention. For these reasons, there is nothing to teach or suggest the combination as suggested by the Examiner.

Even if the combination of Adair and Özer were valid, the combination would not teach all elements of the presently claimed invention. The combination would teach a two layer coating for a glass substrate in which the layers are not prepared by the sol-gel technique, or, if so prepared, have Özer's lower index achieved from Özer's sol-gel process. Such a combination does not teach all elements of applicants' invention for the following reasons. Adair teaches high refractive index layers consisting of transition metals with non-stoichiometric amounts of nitrogen and oxygen. Although niobium is taught to be one of the possible transition metals, titanium is preferred and is used in both of the Examples of Adair. While Adair only mentions niobium oxide in a background discussion of commonly used materials for high refractive index layers, Adair does not use niobium oxide in his own invention in which he adopts other materials and applies these materials by sputtering. In contrast, applicants' invention is directed toward coating layers comprising sol-gel derived niobium oxide with a refractive index of at least about 1.9. Such a material is not taught by the combination of Adair and Özer. Even if the sol-gel derived Nb_2O_5 layer of Özer was utilized in the coating of Adair, it would *still* not teach all elements of the presently claimed invention, because the refractive index of Özer's sol-gel derived layer is only 1.82, which is less than the minimum refractive index exhibited by applicants' layer of 1.90. As disclosed in applicants' specification at page 7, lines 18-21, the sol-gel derived niobium oxide layers are "capable of providing an index of refraction of at least about 1.90, preferably at least about 1.95, more preferably at least about 2.0."

Finally, there is no reasonable expectation of success in the combination of Adair and Özer. As discussed previously, Adair's invention is based on depositing films by magnetron sputtering, preferably with refractive index greater than 2.0. Since the two methods of layer preparation disclosed by Özer are specifically taught to result in films with different optical

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properties, and the sol-gel derived layers are taught to have lower refractive indices (1.82) than those produced by sputtering, there is no reason to expect that producing the layers of Adair by the method of Özer would be successful or achieve sol-gel derived high index layers of indices over 1.90. In fact, it is logical to assume that such layers would be inferior because they would exhibit lower refractive indices, which is undesirable.

For all of the above reasons, the Examiner has not established a *prima facie* case of obviousness.

Even if a case of *prima facie* obviousness had been established, which, for the reasons outlined above it has not, applicants' invention demonstrates unexpected results which overcome such a case of obviousness. Applicants' invention is directed to a thin film optical coating which can be deposited on low-temperature substrates such as plastic or other substrates like glass, in which the niobium oxide layer is sol-gel derived and can produce a refractive index of at least 1.90 and preferably at least 2.0. The invention fulfills a need in the art for a durable material which can be used as a layer having a high index of refraction in a thin film optical coating, and which is inexpensive to prepare in comparison with costly sputtering techniques. Furthermore, the invention fulfills the need for providing such a high refractive index layer on a heat sensitive material such as a plastic because the layers can be produced by low temperature curing. It would not be anticipated based on the cited prior art references that the sol-gel derived niobium oxide layers would exhibit such high refractive indices because, as disclosed in the specification at page 4, lines 25-26, "sol-gel niobium oxide materials are not known to have high indices of refraction." Applicants' invention demonstrates a sol-gel derived niobium oxide layer with high refractive index, and applicants have shown that the use of low temperature curing even allows such layers to be prepared on low-melting substrates such as plastic substrates while maintaining the high refractive index values.

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For all of the above reasons, applicants respectfully request withdrawal of the §103(a) rejection.

In view of the foregoing amendment and remarks, applicants respectfully submit that the pending claims are patentably distinct from the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

NANNING J. ARFSTEN, *et al.*

10/31/08
(Date)

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